Alternatives to SO_3 for Enhanced ESP Performance on Low-Sulfur Coal

Michael D. Durham, Ph.D., C. Jean Bustard, Kenneth E. Baldrey, and Cameron E. Martin

ADA ENVIRONMENTAL SOLUTIONS, LLC
South West Business Center
8100 SouthPark Way, B-2
Littleton, CO 80120
Miked@adaes.com
(303) 734-1727
(303) 734-0330 FAX

For cold-side ESPs collecting high-resistivity dusts, injecting SO_3 into the flue gas is the conventional method for reducing particle resistivity. Although SO_3 conditioning is an effective technique for resistivity reduction, it does have several disadvantages such as increased potential for corrosion, high capital costs for equipment and health and safety concerns related to the toxic nature of the chemicals. In addition, there are many situations where SO_3 conditioning is not very effective. As temperatures increase above approximately 350°F, very high concentrations need to be injected to obtain decreasingly smaller benefits. When the ash is high in alkali materials, such as calcium or magnesium, the SO_3 reacts with the flyash which renders it inactive. With some of the more acidic flyashes, ammonia has to be added so that the ash will respond to conditioning. Finally, there are several new and emerging regulations that could impact decisions on flue gas conditioning systems such as the reporting of Toxic Release Inventories (TRI) and potential regulations to require point sources to measure and report condensable particulate matter as part of the total particulate emissions.

ADA-ES has developed a chemical additive that is designed to provide an alternative to SO_3 for enhancing the operation of ESPs. The additives provide advantages over competing technologies in terms of low capital cost, easy to handle chemicals, and relatively non-toxic chemicals. In addition, the new additive is less sensitive to ash chemistry which will allow the utility complete flexibility to select the most economical coal. Finally, this technology is effective in applications where conventional SO_3 flue gas conditioning does not work such as hot-side ESPs and cold-side ESPs that operate above 375°F.

The research program, which is described in detail in Durham et al., (1996), encompassed an extensive laboratory screening, followed by bench-scale and pilot-scale tests. Based upon experimental results and on knowledge of the additive's chemical and physical

properties, it was apparent the conditioning agent extended the ash *surface* conduction mode to temperatures normally dominated by volume (bulk) conduction.

The first full-scale application of the technology was funded by the Electric Power Research Institute and Central & South West Services (Durham et al., 1997). The program successfully demonstrated that the additive was effective at reducing resistivity of flyash at elevated temperatures. With the flyash reduced, the ESP could operate at higher power levels which increased collection efficiency and decreased opacity. Additional full-scale demonstrations were conducted on hot-side ESPs which are reported in Martin et. al. (1997).

Duke Energy's Cold-Side ESP Demonstration

Duke Energy conducted a month-long evaluation of the ADA-23 flue gas conditioning technology on a full-scale cold-side ESP in July of 1997 (Baldrey et al, 1997). Their interest in this technology was based upon the less-toxic nature of the chemical and its ability to respond to many different coals.

The demonstration was conducted on Unit 2 at the 400 MW Marshall Steam Plant in Catawba County, NC. The ESP has two chambers and two cells per chamber with 30 feet high plates spaced at 9 inches and weighted wire discharge electrodes. The specific collection area is relatively small at approximately 146 ft^2/kacfm.

A wide variety of low-sulfur Eastern coals are burned at Marshall including as many as three different coals in a single day. This variety in the fuel source creates a need for a flue gas condition technology that can respond quickly to the changing ash chemical and physical characteristics. In general, the coals are low in sulfur and are rather acidic, in that the total of silica and alumina oxides range from 80-90%.

The injection of ADA-23 began on June 29, 1997 and continued until July 29, 1997. The results obtained with the ADA-ES flue gas conditioning technology on Unit 2 compared very favorable with SO_3/NH_3 conditioning results obtained on Unit 1 burning the same coal. The new conditioning technology was able to maintain opacity well below the 20% compliance level for the entire month.

Conclusions

The test results indicated that ADA-23 was an effective conditioning agent for a cold-side ESP collecting ash generated by low-sulfur coals. The conditioning agent demonstrated the ability to reduce resistivity for flyashes generated from a variety of different coals. Once the resistivity of the dust layer was reduced, the ESP was able to operate at higher power levels resulting in enhanced collection and reduced opacity. Specific advantages associated with this new additive technology include:

the chemical is less hazardous; reduces particle resistivity;

while different coal ashes require different treatment ratios, the additive was effective on a variety of coals which allows the user a wider range of options in purchasing coal;

it responds faster to changes in flyash characteristics than SO_3;

the injection system is simple

conditioned ash remains suitable for commercial use; and

ash handling is not impaired at conditioning levels required for resistivity control.

Because of these advantages, ADA-ES expects to fill the following niches for improving performance of ESPs:

Higher temperatures: Hot-side ESPs, Warm (>350oF) ESPs, Refinery Cat Cracker ESPs;

older units with limited operating life remaining;

units that only need conditioning for parts of the year; and

units that burn several coals, only a few cause problems

BIBLIOGRAPHY

Durham, M.D., K.E. Baldrey, C.J. Bustard, and C.E. Martin (1996). Full-Scale Demonstration of Novel Flue Gas Conditioning Agent for Enhanced Toxic Particulate Control, AWMA 89th Annual Meeting, Nashville, TN, June 23-28.

Durham, M.D., K.E. Baldrey, C.J. Bustard, C.E. Martin, and N.N. Dharmarajan (1997) New ESP Additive Controls Particulates, **Power Engineering**, June.

Baldrey, K E., C.E. Martin, , C.J. Bustard, M.D. Durham, S. Williams, and L. Jenkins (1997). Duke Energy's Operating Experience with ADA-ES Flue Gas Conditioning Technology on a Cold-Side ESP, Power-Gen International '97, Dallas, TX, December 9-11.

Martin, C.E., K E. Baldrey, C.V. Lindsey, C.J. Bustard, M.D. Durham, W. Harrison, B. Corena, and J. Rush (1997). Southern Company's Operating Experience with ADA-ES Flue Gas Conditioning Technology on Hot-Side and Cold-Side ESPs, Power-Gen International '97, Dallas, TX, December 9-11.